Syracuse University QuarkNet Summer 2015 Workshop Summary

September 15, 2015

Syracuse University QuarkNet mentors organized a 4-day long workshop, held in the Physics Department from Monday, July 13 - Thursday, July 16. The workshop featured a combination of MasterClass activities and explorations with cosmic-ray detectors. This year there were 3 participants of the workshop (Joshua Buchman, Michael Madden, and Justin Shute), with the lower attendance attributable to several of our regular participants being unable to attend. In spite of the low attendance, many fruitful activities were pursued, and the participating teachers expressed continued enthusiasm about the QuarkNet program.

Days 1-2 of the workshop were led by Shane Wood from QuarkNet, who guided our teachers through the CMS MasterClass. Mr. Wood created a webpage with an agenda for these days of the workshop, which can be found at: `https://quarknet.i2u2.org/page/cms-data-workshop-syracuse`. Activities conducted during these days were:

- Presentation by Mitch Soderberg on the CMS experiment and they physics of interest post-Higgs discovery.

- Rolling with Rutherford and Quark Workbench "hands-on" activities.

- Investigations with CMS data and web-based tools.

- Discussion and development of implementation plans.

Days 3-4 of the workshop were led by Mitch Soderberg, and focused on explorations with cosmic-ray detectors that the participating teachers had built in prior years. Activities pursued during these days included:

- Using detectors to search for "shower" events, where detectors are operated in an array geometry as opposed to a stacked geometry. Data from these searches were uploaded to the e-lab site, and subsequent analysis was performed to look for coincidence of shower events between different detectors.

- Using detectors to measure the speed of cosmic muons. This was accomplished by separating pairs of scintillator paddles by $\sim$2 meters, and attempting to measure the time delay between 4-fold coincident events. The teachers found that the e-lab site didn't seem to have tools for this type of investigation, so they developed their own method for importing the raw text files from the detectors into an Excel spreadsheet

and then determining the time delay. Subsequent inquiry led to a version of the Java software from Purdue with a "Muon Lifetime" component that made this activity much simpler.

- Measurement of the muon lifetime.

Figure 1: Picture from Summer 2015 QuarkNet Workshop at Syracuse University.